PCT-Appln 10366

(12) UK Patent Application (19) GB (11) 2 017 240 A

(21) Application No 7908593
(22) Date of filing 12 Mar 1979
(23) Claims filed 12 Mar 1979
(30) Priority data
(31) 890757
(32) 27 Mar 1978
(33) United States of America (US)
(43) Application published 3 Oct 1979
(51) INT CL²
B60T 11/20
(52) Domestic classification
F2F FA
(56) Documents cited
GB 626073
GB 507989
GB 501312
(58) Field of search
F2F
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(54) Master Cylinder

(57) A master cylinder has a housing with a (stepped) bore (28) therein having a tapered section (34) located between first and second compensator ports (40, 42) connecting the bore (28) to a reservoir (44, 46). A stepped sleeve (74) locates first and second lip seals (114, 115) adjacent the first and second compensator ports (40, 42) respectively. A first piston (52) engages the first lip seal (114) and a second piston (54) engages the second lip seal (115) to define first (56) and second (72) chambers within the bore (28). A bearing member (110) which surrounds the first piston (52) engages the sleeve (74) and holds the first (114) and second (115) lip seals in a stationary position within the bore (28). Thereafter, an input member (24) moves the first (52) and second (54) pistons past the first (114) and second (115) lip seals to pressurize the fluid in the first (56) and second (72) chambers and provides fluid pressure responsive devices (14, 16) with an operational input through first and second outlet ports in the housing.

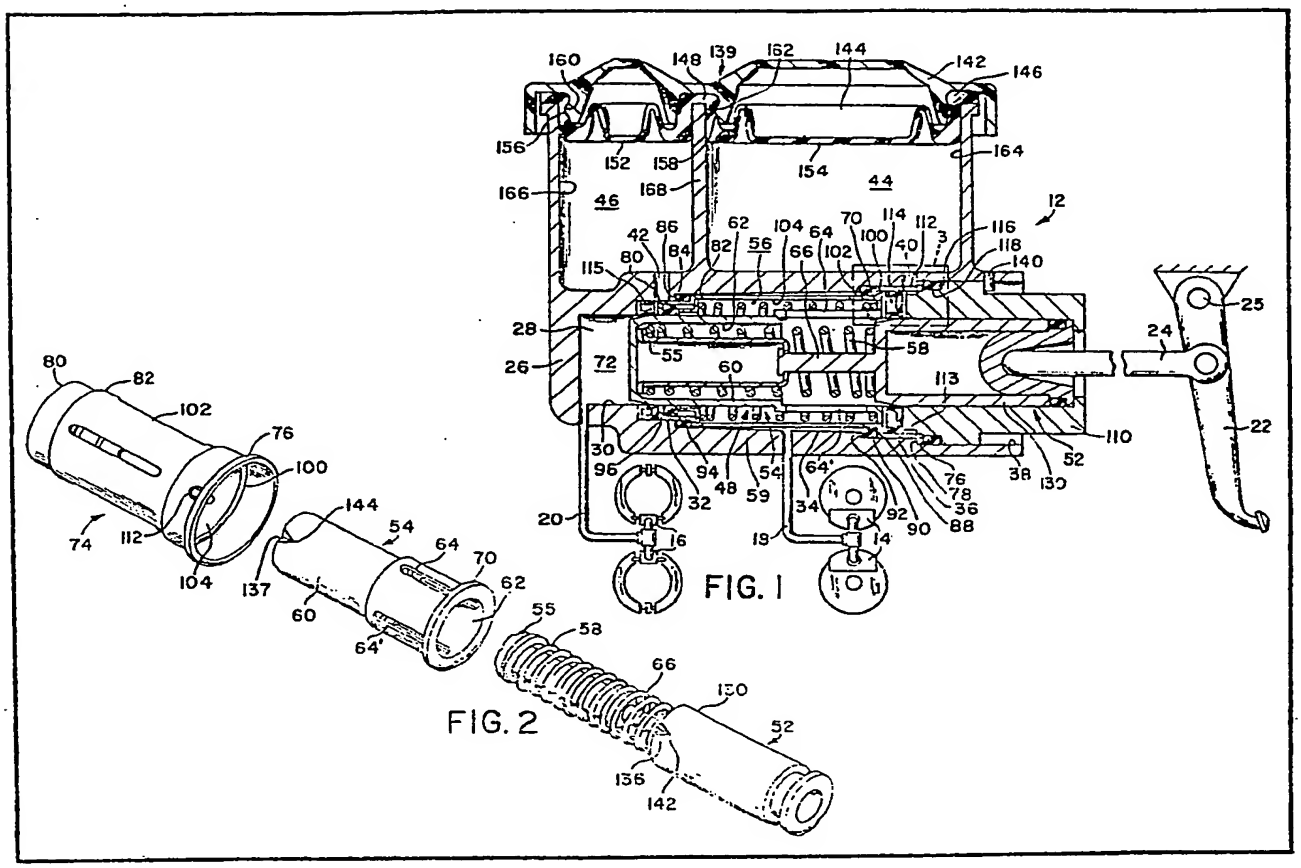

FIG. 1

FIG. 2

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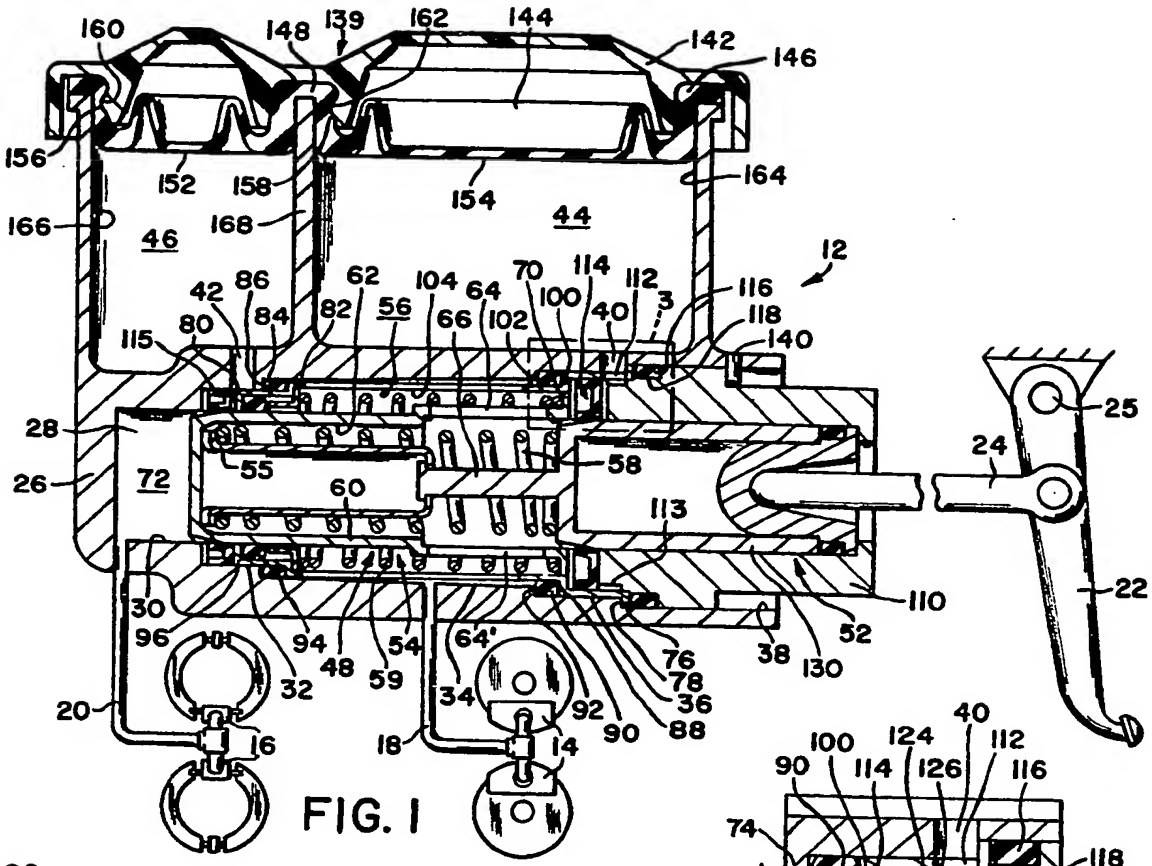


FIG. 1

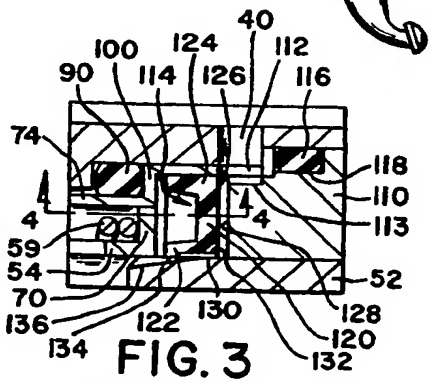
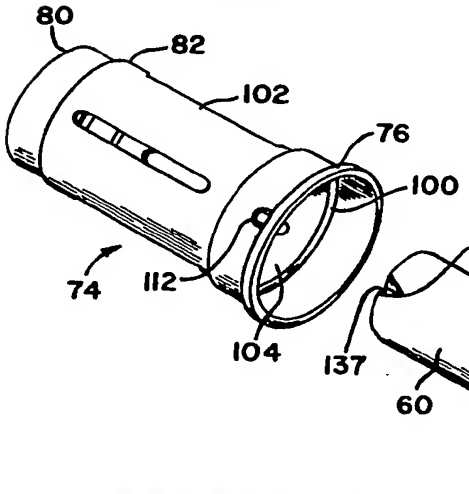


FIG. 3



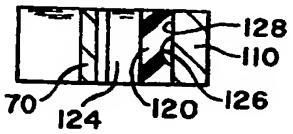


FIG. 4

FIG. 2

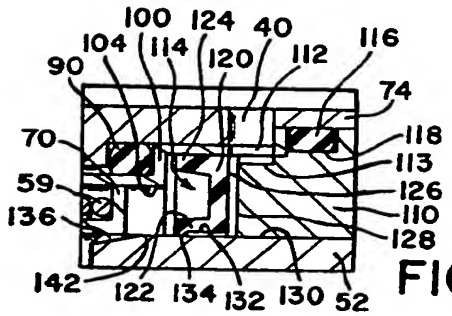


FIG. 5

SPECIFICATION

A Master Cylinder

The invention relates to a master cylinder, in particular for the braking system of a vehicle.

The manufacture of master cylinders is usually achieved through either sand or permanent mold casting of molten metal to a particular shape. When the molten metal has cooled, the sand or core is removed from any cavities therein. As the molten metal cools, a uniform dense surface is created on the periphery of the casting; however, some voids may occur internally. Thereafter when the casting is machined to its final tolerance, such as the master cylinder housing disclosed in U.S. Patent 3,701,257, it is possible that some of the voids may be exposed in the pressurizing chambers. If a master cylinder were assembled having a void exposed in the bore, in addition to providing a possible leak path for the high pressure fluid in the pressurizing chamber, it is possible to damage the seals as they are moved past such voids. Thus once a void is exposed in the bore through machining for safety, the master cylinder casting is automatically scrapped. It is estimated that between 2 and 5 per cent of the castings manufactured during any given period of time are scrapped because of the potential hazards created by the exposure of voids during machining.

It has been observed that die casting, when compared with sand or permanent mold castings, produces a smoother surface finish with thinner dimensions and closer manufacturing tolerances.

An object of the present invention is to provide a master cylinder having a die cast surface with a piston arrangement to pressurize the fluid therein in response to an operator input force.

A further object of the present invention is to provide a master cylinder having a tapered operational bore therein with a piston arrangement through which fluid is pressurized and supplied to a fluid pressure responsive device.

According to the present invention, there is proposed a master cylinder comprising a housing in which is defined a bore, piston means comprising a first and a second piston movably disposed within said bore for defining therein a first and a second pressure chambers adapted to be connected to first and second pressure responsive means respectively, each of said pistons cooperating with a corresponding seal for controlling fluid flow from a fluid reservoir to the respective pressure chambers, characterized in that said bore is tapered, a sleeve member being located in said tapered bore, said first and second seals being associated with said sleeve member, said first and second pistons engaging said first and second seals, and cooperating with said housing to define said first and second chambers, bearing means surrounding at least a portion of said piston means and engaging said sleeve member to hold said first and second seals in a stationary position within said bore.

The invention will now be described, by way of example, with reference to the accompanying drawings wherein:

Figure 1 is a schematic illustration of a brake system having a sectional view of a master cylinder made according to the present invention;

Figure 2 is an exploded perspective view of the piston assembly of the master cylinder of Figure 1;

Figure 3 is a sectional view of circumscribed line 3 of Figure 1 showing the relationship between the sleeve, lip seal, primary piston and bearing member of the piston assembly in a released position;

Figure 4 is a sectional view taken along line 4—4 of Figure 3; and

Figure 5 is a sectional view of circumscribed line 3 of Figure 1 showing the relationship between the sleeve, lip seal, primary piston and bearing member of the piston assembly in an operational position.

In the brake system 10 shown in Figure 1, a master cylinder 12 is connected to the front wheel brakes 14 and the rear wheel brakes 16 by conduits 18 and 20 respectively. In response to an operational input applied from a brake pedal 22 through a push rod 24, the master cylinder 12 is operated to effect a brake application.

In more particular detail, the master cylinder 12 has a die cast housing 26 with a bore 28 located therein. Bore 28 has a series of steps 30, 32, 34, 36 and 38 which have a slope or taper of about 1° with respect to an axial plane through bore 28. Such a slope or taper is placed in the housing during die casting and is necessary to permit the removal of die cast core after the metal in the housing 26 has cooled from a molten condition. The housing 26 has a first compensator port 40 and a second compensator port 42 through which bore 28 is connected with compartments 44 and 46, respectively, in the fluid reservoir.

A piston assembly 48 which is located in bore 28 has a first piston 52 and a second piston 54. As shown in Figure 2, the second piston 54 has a cylindrical body 60 with a first diameter and a second diameter. The cylindrical body 60 has a bore 62 which extends through the first diameter and into the second diameter. A series of openings 64, 64', 64", and 64"', connects the bore 62 with bore 28. A retainer 55 located in bore 62 has a stem 66 attached to piston 52 for caging a spring 58 and thereby initially establish a distance between pistons 52 and 54 to establish the size of a first pressure chamber 56 in bore 28.

Piston 54 has an outwardly projecting lip 70 which engages one end of a spring 59 to hold the second piston 54 away from the bottom of bore 28 and establish the size of a second pressurizing chamber 72.

A sleeve member 74 has a first end 76 that engages a shoulder 78 which separates steps 36 and 38 so that its second end 80 is located adjacent compensator port 42. A lip seal 115 in step 32 of bore 28 is also positioned by end 80 to control communication of fluid between

chambers 46 and 72. Sleeve member 74 has a shoulder 82 that locates an O-ring seal 84 against a shoulder 86 separating steps 32 and 34 to prevent fluid communication from chamber 56 between steps 32 and 34 of bore 28. Additionally, sleeve member 74 has another shoulder 88 thwt locates an O-ring seal 90 against a shoulder 92 separating steps 34 and 36 to prevent fluid communication from chamber 56 between steps 34 and 36.

Similarly, an O-ring seal 94 located adjacent a rib 96 positioned at the second end of the sleeve member 74 by a spring retainer 98, engages the cylindrical body 60 of piston 54 to prevent fluid communication between chambers 56 and 72.

As illustrated in Figures 1 and 2, sleeve member 74 has a leg 100 that aligns its cylindrical body 102 within bore 28 to compensate for the taper or slope in step 34 between the first and second compensator ports 40 and 42. Lip 70 engages the interior surface 104 of member 74 and cylindrical body 102 engages bearing surface 106 of rib 96 to align or centrally position piston 54 in step 32 of bore 28.

A bearing member 110 which surrounds the cylindrical body of piston 52 engages end 76 of sleeve 74 to position a lip seal 114 adjacent leg 100 and align passages 112 with compensator port 40 and a groove 113 in bearing 110. A seal 116 located in a groove 118 of the bearing member 110 prevents fluid communication from compensator port 40 to the surrounding environment along step 38 of bore 28.

A snap ring or other fastener 140 engages bearing member 110 to hold the piston assembly 48 within the bore 28.

To assure that bore 28 is communicated with the reservoir, lip seals 114 and 115 and pistons 52 and 54 cooperate to define positive flow paths, as shown in Figures 3 and 4, between chamber 56 and compartment 44 and chamber 72 and compartment 46, respectively.

Lip seals 114 and 115 are identical with exception of size and thus the specific details shown with respect to lip seal 114 in Figures 3 and 4 are equally applicable to lip seal 115.

Lip seal 114 has an annular base 120 with legs 122 and 124 attached thereto. A series of radial grooves 126, only one being shown in Figures 3 and 4, which are located on the back side 128 of the base 120 provide a flow path from groove 113 in bearing 110 to the cylindrical surface 130 of piston 52. A groove 132 on the peripheral surface 134 of leg 122 connects the radial grooves 126 with a series of fluted grooves 136 on the end of the cylindrical surface 130 to define a positive flow path between compartment 44 into chamber 56 to maintain the fluid therein in completely filled condition.

A cover member 139 having a cap 142 and a diaphragm 144 is attached to housing 260. The diaphragm 144 has a first bead 146 on its peripheral surface and a second bead 148 which separates the diaphragm 144 into two sections, 152 and 154. A first groove 156 is located in the first section 152 and a second groove 158 is located in the second section 154. The cap 142 has ribs 160 and 162 thereon which are located in grooves 156 and 158 to resiliently bias the diaphragm 144 toward walls 164, 166 and 168 and attach the cover member 140 to the housing 26 and thereby seal compartments 44 and 46 from the surrounding environment.

When an operator desires to make a brake application in a vehicle equipped with a brake system as shown in Figure 1, an input force causes pedal 22 to move in an arc about pin 25 and provide push rod 24 with a linear input. This linear input simultaneously moves the fluted grooves 136 and 137 on pistons 52 and 54 past grooves 132 and 133 as return spring 59 is overcome to interrupt communication between chambers 56 and 72 and compartments 44 and 46, respectively. Movement of pistons 52 and 54 into chambers 56 and 72 causes a fluid pressure to proportionally increase therein and supply wheel brakes 14 and 16 with fluid pressure to effect a brake application.

As shown in Figure 5, the lip seal 114 remains stationary as piston 52 moves into chamber 56 to pressurize the fluid therein. The fluid pressure in chamber 56 acts on lip seal 114 to hold leg 124 against sleeve 74, surface 128 against bearing 110 and surface 134 of leg 122 against the cylindrical surface 130 of piston 52 to prevent fluid communication to compartment 44 of the reservoir.

Upon termination of the input force on pedal 22, return spring 59 acts on the second piston 54 and moves the first and second pistons 52 and 54 toward stop 140. As tips 142 and 144 of fluted grooves 136 and 137 reach grooves 132 and 133, fluid communication between chambers 56 and 72 and reservoir compartment 44 and 46 is initiated through a defined flow path established by grooves 126 to assure that any fluid which could be lost from the brake system is replenished prior to another application of input brake force by an operator.

Claims

1. Master cylinder comprising a housing in which is defined a bore, piston means comprising a first and a second piston movably disposed within said bore for defining therein a first and a second pressure chambers adapted to be connected to first and second pressure responsive means respectively, each of said pistons cooperating with a corresponding seal for controlling fluid flow from a fluid reservoir to the respective pressure chambers, said bore being tapered, a sleeve member being located in said tapered bore, said first and second seals being associated with said sleeve, member, said first and second pistons engaging said first and second seals, and cooperating with said housing to define said first and second chambers, bearing means surrounding at least a portion of said piston means and engaging said sleeve member

to hold said first and second seals in a stationary position within said bore.

2. Master cylinder according to claim 1, wherein said sleeve member includes a plurality of openings through which the fluid in the first chamber is communicated to a first outlet port.

3. Master cylinder as claimed in claim 2, wherein said piston means includes a first cylindrical member located in said tapered bore by said bearing means, and a second cylindrical member located in said tapered bore by a lip on said sleeve member.

4. Master cylinder, as claimed in claim 3 further including a first spring located between said first and second cylindrical members to establish the size of said chamber and a second spring located between said second cylindrical member and said sleeve member for urging said first and second cylindrical member out of said first and second chambers toward a rest position.

5. Master cylinder according to claim 4, wherein said first and second seals each include a plurality of radial grooves for establishing a definite flow path between the reservoir and the bore.

6. Master cylinder according to claim 5, wherein said first and second cylindrical members each include a fluted section located on the end thereof for defining an extension between said definite flow path and the first and second chambers.

7. Master cylinder according to claim 6, wherein said second cylindrical body includes a first diameter section and a second diameter section, said first diameter section having a lip on the peripheral surface thereof for engaging said second spring, said lip engaging said sleeve member to maintain the first diameter section in substantially the center of said bore in said second chamber.

8. Master cylinder according to claim 7, wherein said second cylindrical body further includes a second bore that extends through said first diameter section and into said second diameter section, said first spring being located in said second bore to provide a compact unitary structure.

9. Master cylinder according to claim 8, wherein said second cylindrical body further includes a plurality of openings located in said first diameter section to allow fluid to freely flow between the second bore and the first chamber with relative movement between the first and second cylindrical members.

10. Master cylinder according to claim 9, further including a wall for separating the reservoir into first and second compartments, a diaphragm having a first bead on its peripheral surface and second bead, said first and second beads having grooves thereon; and cover means having first and second ribs thereon located in said grooves for biasing said first and second beads against said housing and wall to seal said first and second chambers from the surrounding environment.

11. Master cylinder substantially as hereinabove described and as shown on the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1979. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.